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GROUND-WATER SEEPAGE ANALYSIS FOR 100 CONGRESS AVENUE PHASE I, AUSTIN, TEXAS

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INTRODUCTION

This report presents the findings of a ground-water seepage analysis for the 100 Congress Avenue Phase I office building, Austin, Texas. It addresses the maximum flow and probable average flow of ground water from subsurface alluvial soils to a subgrade drainage collection system. The analysis was performed at the request of Lincoln Property Company, Austin, Texas.

PROJECT DESCRIPTION

The building site is located in downtown Austin and is bounded on the east by Congress Avenue, on the north by West 2nd Street, on the west by Colorado Street, and on the south by West 1st Street. Town Lake on the Colorado River is located approximately 250 feet south-southwest of the site perimeter. The building occupies the east one half of the city block described above and is dimensioned 160 feet by 290 feet.

The project includes a five-level parking facility constructed below grade and directly beneath the multi-story office building. Excavation for the facility is complete and extends approximately 50 feet below street level. Construction plans call for granular backfill between the subgrade building walls and near-vertical sides of the excavation, to permit seepage to drain vertically to a horizontal collector system around the base exterior of the walls. Collected seepage will be pumped from the basement level to prevent build up of hydrostatic uplift pressure.

SUBSURFACE SOIL AND HYDROLOGIC DATA

Maxim Engineers, Inc., of Austin, Texas, performed a geotechnical investigation of the site and described general subsurface conditions in its Report No. L-4-A110, dated 9 October 1984. The report includes the logs of eleven soil borings drilled at the site, data concerning the physical properties of subsurface soils, and measurements of ground-water levels in the completed borings.

Subsurface stratigraphy at the site is relative simple and includes five principal geologic formations. From shallowest to deepest they are alluvial terrace deposits; Austin chalk, Eagle Ford shale, Buda limestone, and Del Rio shale. The formations are nearly horizontal in attitude, and their thicknesses are relatively constant across the site. Excepting the alluvium, the composition of each formation is very consistent across the site. The thickness, depth, and elevation of each unit is given below. All depths in the table and the remainder of this report are referenced to an average site elevation of 470 feet NGVD (National Geodetic Vertical Datum).

Stratigraphic Unit	Average Depth (ft)	Average Elevation (ft)	Average Thickness (ft)
Alluvium	0	470	35
Austin Chalk	35	435	5
Eagle Ford Shale	40	430	39
Buda Limestone	79	391	36
Del Rio Shale	115	355	36

The alluvium is variable in composition and can be differentiated into three, layered intervals. From ground surface to a depth of 11-14 feet, soils are primarily silty to sandy clay with minor amounts of clayey sand. From the base of the upper interval to depths of 22-32 feet (average 28 feet), the alluvium is mainly fine grained silty sand, some fine sand and clayey sand, and minor amounts of clay. Underlying the middle interval to a depth of 33-40 feet (average 35 feet), the alluvium consists of gravelly sand to sandy gravel.

During drilling, ground water was encountered between depths of 32 feet and 35 feet in four borings. At the completion of drilling, water levels in another three borings were between depths of 28 feet

and 37 feet. Water levels in two borings were measured 2 to 4 days after completion and were found to be at depths of 24.5 and 25 feet. Since excavation at the site was completed, the maximum rate of ground-water seepage encountered has been about 6 gal/min. In addition, the seepage has occurred only along the north face of the excavation, where the base of the alluvium is 3-5 feet lower than indicated by site borings in other areas of the site.

The normal pool elevation of Town Lake is 428 feet, which is lower than the base of alluvium at the building site. Hence, at normal pool elevation Town Lake does not provide a source for ground-water seepage at the site. The highest recorded elevation of Town Lake since 1959 was 433 feet in June 1981. The projected elevation of Town Lake resulting from a 100-year flood event on the Colorado River is 444 feet. An evaluation of seepage at the higher lake elevation is included in the seepage analysis in this report.

ASSESSMENT OF GROUND-WATER CONDITIONS

The alluvium appears to be the only potential source of significant ground-water seepage, as the underlying Austin chalk and Eagle Ford shale are relatively impermeable. Further, only the middle and lower alluvium are sufficiently permeable to produce significant flow. Based on their general textural characteristics, the middle and lower alluvium can be expected to have hydraulic conductivity values between 10^{-3} cm/sec and 10^{-1} cm/sec. A value of 2.5×10^{-2} cm/sec used for preliminary seepage estimates (Maxim Engineers, Inc., personal communication) appears to be sufficiently conservative and is also used in this report's analysis.

Water-level measurements in site borings varied from 24.5 to 37 feet in depth and indicate that alluvium ground water is unconfined and subject to gravity flow, rather than artesian flow. Based on the water levels measured during and immediately after drilling, only the lowermost 2-5 feet of alluvium is saturated. Shallower levels measured 2 to 4 days after drilling were probably influenced by the hydrostatic pressure of deeper formations.

Though no definitive data were available, it is reasonable to assume that ground water at the site is derived from surface infiltration of rainfall in unpaved areas and leakage from underground utility line trenches and storm-water and sewer pipelines. The amount of recharge from surface infiltration is expected to be very low. Ground water is also assumed to flow toward Town Lake from areas north of the lake.

SEEPAGE ANALYSIS

Ground-water seepage was estimated for probable average conditions and a worst-case scenario. Equations used in the analysis are approximations and assume flow to a single well or slot that fully penetrates an unconfined aquifer, with either a circular or line source of ground water. A well radius of 145 feet was used to represent the building excavation and the hydraulic conductivity of the alluvium was assumed to be 70 ft/day 2.5 x 10^{-2} cm/sec).

Probable average conditions were estimated for an assumed saturated alluvium thickness of 3 feet, which was the average saturated thickness when the geotechnical investigation of the site was performed. A seepage rate of 10 gal/min was computed. Noting that actual seepage at the site has not exceeded 6 gal/min since excavation was completed, a flow of 10 gal/min is conservatively representative of average site conditions.

Increased ground-water seepage will occur in response to a rise in ground-water levels in the building vicinity. A worst-case scenario was evaluated by assuming a 10-foot saturated thickness of alluvium. Under such conditions, the rate of flow was estimated to be approximately 100 gal/min. However, it should be noted that the occurrence of such water levels is highly improbable, as explained below.

Ground-water in the alluvium is normally derived from recharge at the ground surface and from buried utility lines in the downtown area. A dramatic rise in water levels is seen as occuring only if the level of Town Lake rose to its 100-year flood level (444 feet) and remained at that level sufficiently long to saturate the alluvium between the lake and building site. Significant variations in seepage would

not occur until this saturation was complete. Given the assumed alluvium permeability of 70 ft/day, an assumed porosity of 35 percent, and a distance of 200 feet between the elevated lake and the building site, it was estimated that at least 20 days would be needed for infiltrating lake water to move through the alluvium to the building site. In reality, the likelihood that Lake Austin would remain at flood level for this length of time is practically negligble and certainly far less than the probability of a 100-year flood event (one percent in any year).

CONCLUSIONS AND RECOMMENDATIONS

The seepage rates computed for the building site were developed using assumptions of ground-water levels and permeability characteristics of alluvial soils. It should be recognized that the accuracy of the assumptions is limited, and the resultant seepage estimates are subject to error. However, conservative assumptions were used, and projected seepage rates should provide an adequate margin of safety.

Seepage rates at the site are estimated to vary from about 10 gal/min to 100 gal/min. EH&A recommends that the dewatering system be designed to handle a maximum flow rate of 100 gal/min.